Approval and Communication of Refinery, Maintenance, or Engineering Instructions

Document No.: RI-642	**Title:** Positive Materials Identification (PMI)	**Current Date:** 12/2011
Action: ☐ New ☒ Revision ☐ Cancellation		**Next Revision Due:** 10/2016
Responsible Organization: Maintenance & Reliability	**Position to Contact With Questions/Suggestions:** QM Team Leader	

Summarize Rewritten Material: **Review:** **Minor** ☐ **Complete** ☒

- Section 1.1.2 and 6.1: Changed term "Metal Craft Quality Assurance" document name to "Richmond Refinery Weld Inspection Requirements for Piping Fabrication"
- Section 3.2 and 5.5: Removed reference to "Texas Nuclear" brand analyzers as the prefered instrument
- Section 6.1 and 6.2: Removed term "Weld Rod Policy" and replaced with "Filler Metal Policy"
- Minor grammer changes made within document

REQUIRED COMMUNICATION/TRAINING

If Type 2 or Type 3 training is necessary – Instruction Owner is responsible for developing the training material and must work with Development Department Manager and Managers of affected personnel to coordinate training of affected personnel and documentation of training.

This document should be reviewed by:	**Type 1 Simple Change**	**Type 2 On-The-Job Training**	**Type 3 Classroom Training**
All Refinery Personnel	☐	☐	☐
Operations	☐	☐	☐
Maintenance & Reliability	☒	☐	☐
Technical	☒	☐	☐
HES	☐	☐	☐
Other:	☐	☐	☐

Necessary Approval for Instructions:

- Refinery Instructions: *Standard RI approvals have been check marked*
- Safe Work Practices: Development, Operations, Maintenance & Reliability, HES, and Refinery Manager
- Emergency Plans (400 Series RIs): Development, Operations, Maintenance & Reliability, HES, and Refinery Manager
- Engineering Instructions: Technical and HES Manager
- Maintenance Instructions: Maintenance & Reliability and HES Manager
- Cancellation of Instruction: Owner and Refinery or Appropriate Dept. Manager

APPROVALS

☒	**Instruction Owner:** John Torres	☒	**Development Manager:** *(first signature before final routing)* Rick Smith
☒	**Operations Manager:** Bruce Chinn	☐	**Technical Services Manager:**
☒	**HES Manager:** Dave Feiglstok	☒	**Maintenance & Reliability Manager:** Jay Peterson
☒	**Refinery Manager:** *(final signature)* Nigel Hearne	☐	**Other Manager:**

On Completion – Instruction Owner will send file and message to IPC to post on the Refinery server.

RICHMOND REFINERY INSTRUCTIONS

EQUIPMENT INSPECTION, MAINTENANCE, ETC.

POSITIVE MATERIALS IDENTIFICATION

TABLE OF CONTENTS

RICHMOND REFINERY INSTRUCTIONS

EQUIPMENT INSPECTION, MAINTENANCE, ETC.

POSITIVE MATERIALS IDENTIFICATION

1.0 PURPOSE

1.1 This Instruction covers the general procedures to be followed to positively verify the material of new or replacement equipment and piping installed in the Refinery to prevent a safety-related incident. This Instruction identifies departmental responsibilities to ensure that required material compositions are verified and documented.

1. Major Capital Project work involving Engineering, Procurement, and Construction Contractors should comply with the Reliability Best Practice "PMI Process for Capital Projects."

*2. Refinery Engineering and Maintenance organizations, including contractors, may refer to the Richmond Refinery Weld Inspection Requirements for Piping Fabrication for more detailed guidance on local practice.

1.2 The philosophy of this Positive Materials Identification (PMI) Refinery Instruction is to enable consistent and reliable work processes that eliminate failures of Refinery equipment due to the installation of incorrect materials during Refinery maintenance or project work.

1.3 Although not the intent of this document, PMI techniques may be used to verify other alloy component materials, such as pump internals and heat exchanger tubes, which may ensure mechanical availability, reliability, and mitigate premature failure, but have no effect on safety.

2.0 BACKGROUND

*2.1 Significant failures and fires have occurred in our industry due to the installation of incorrect materials. OSHA 1910.119 requires that "equipment as it is fabricated is suitable for the process application." Our Mechanical Integrity Program says that this requirement will be met in part, by "construction materials and will be field verified as correct." Through our PMI efforts, we will ensure continued safe operation by positively identifying material before exposure to potentially vulnerable service conditions.

3.0 GENERAL GUIDELINES

*3.1 Pressure containing components made from materials outlined in Appendix I must have their composition verified before exposure to process conditions This

verification takes place in stages as the material is handled through the various Refinery organizations. When a material has been verified as having an acceptable composition, it must be stamped or chemically etched with the letters "PMI" and/or suitably documented to ensure traceability. Color coding and transferring material data information with low-chloride paints will also be required on pipe and plate as outlined in subsequent sections. Unless stated otherwise, each component material type (e.g., pipe, valve, weld) listed in Appendix I must be verified through the Positive Material Identification process on receipt and when installed.

*3.2 Preferred verification instruments are (Refer to RI-9020, Radioactive Materials.) Alternate verification instruments containing radioactive sources must be approved by the Radiation Safety Officer (RSO), the Equipment Reliability Group, and the State of California before they are received into the Richmond Refinery. Field chemical or laboratory analyses of samples are also acceptable PMI methods, but do not provide immediate results.

1. Each organization shall select the PMI equipment best suited to perform the tasks of that organization, and shall be completely familiar with functions, limitations, and safety features to fulfill PMI requirements safely and accurately.

2. Each organization using PMI equipment shall ensure regular competency training of personnel, as stated in Sections 3.4 and 3.5.

3.3 There are several acceptable techniques to identify, mark, and document material that requires PMI.

1. Material Color Coding adopted by USA Refining is identical to Pipe Fabrication Institute recommended practice ES-22 for color coding. This color code, shown as Appendix II, is to be used as an alternative to other methods throughout the Refinery by Purchasing, shop fabricators, and on-site contractors. Painted color stripes along the longitudinal axis of component materials are required by this technique. Do not use color "bands." See Appendix III for placement of color coding and stamping. Paints used for color coding shall be durable and of distinctive color. Paints containing sulfur, lead, or other low-melting point metals or halogens are not acceptable. Low-chloride marking materials are acceptable.

2. Chemical-etching methods of marking materials with the PMI logo and approved techniques are stated in the Corporate PMI Guidelines.

3. Steel die stamps, when used to identify a material, must produce a low-stress mark which has lettering made up of round-nose indentors or an interrupted-dot matrix. A vibrating pencil may also be used where stamping is impractical or may cause damage to the component.

4. Weld Inspection tables, construction isometrics, and the Refinery isometric database are all suitable methods to document PMI.

3.4 Only qualified personnel shall be used to conduct material verifications. Each Refinery organization that performs materials verification shall ensure that personnel within the organization are trained and qualified to safely use the analysis tool utilized to make the verifications. This training and qualification shall be documented for each employee and the documents maintained to reflect the status of employees using the analysis tools.

1. The Refinery Development Department is responsible for maintaining the training records. Materials analyzers that use a radioactive source in order to identify a material's composition require employees to be trained and qualified by the manufacturer of each type of analyzer. An employee may be trained by and use the analyzer under the supervision of an employee trained and qualified by the manufacturer.

   Before any employee is permitted to use alloy analyzing instruments that possess radioactive nuclide sources, they must be approved by the State of California and listed on the site's Radioactive Materials License.

2. Personnel qualified to perform PMI using such analyzers shall recertify their qualification(s) every three years. Qualification for each type of analyzer or technique requires demonstrating the ability to:

   a. Safely use the verification tool.

   b. Properly use and refer to the ASTM specifications to determine the alloy being analyzed.

   c. Properly verify and apply the Refinery color coding system, or identify and verify PMI stamping.

   d. Properly document and report the findings that are consistent with organization requirements.

   e. Apply the philosophy of the PMI process.

3.5 The success of the program requires a high level of quality control by all employees and everyone shares this responsibility. The organizations mentioned in the following sections have logistical responsibilities for the deployment of PMI.

1. Department first-line supervisors are responsible for ensuring that the personnel performing these inspections are qualified and for monitoring their department's efforts to ensure that all qualification and practical documentation is properly completed. The Maintenance Manager will ensure overall compliance.

2. The Reliability Manager will commission an annual audit of the PMI process. This audit will be identified as a CAP Task. An audit team will be established with representatives from the following work groups:

   a. Engineering/New Construction

   b. Purchasing

   c. Maintenance

   d. Turnaround

4.0 ENGINEERING RESPONSIBILITIES (THIS INCLUDES BOTH PROJECT AND DIVISION ENGINEERING)

4.1 All material requisitions and work orders (GO-111s, Bill of Materials, Maximo, or Engineering work orders) for materials requiring verification, as shown in Appendix I, issued through Purchasing or through alliance procurement will specify a requirement for PMI. In addition, Certified Material Test Reports (CMTRs) are required for all code work and should include chemical and mechanical properties, heat treatment, and applicable impact testing data that may be specified in the material requisition or work order for additional verification and cross-referencing.

4.2 An Authorized Inspector as defined by the applicable code of construction or repair shall verify code material, which may include PMI in addition to the review of CMTRs.

4.3 All work orders with materials requiring PMI, as shown in Appendix I, shall indicate the required PMI by Purchasing, alliance, and maintenance organizations including any arrangement for field PMI by the reliability organization.

For reference, weld procedures specified in work orders should reflect the materials for a given service and be compatible with component materials as qualified to applicable code requirements.

4.4 The Weld Inspection Record table can also be included on the drawing or construction isometric. The Weld Inspection Record should also be initiated by the Design Engineer and included with preexisting spool drawings that are issued for the replacement of existing spools.

4.5 All orders for fabricated equipment shall specify shop PMI inspection at the manufacturer's facilities per the Shop Fabrication and Field Installation requirements (Section 6.7) of this Instruction.

4.6 Documentation of PMI (and any other code documentation) shall be copied to the appropriate work order file.

5.0 PURCHASING RESPONSIBILITIES

5.1 All storehouse stock and direct alliance procurement orders requiring PMI, per Appendix I, will be verified and documented as requiring positive materials identification by Chevron's receiving personnel upon delivery. All PMI documentation will be forwarded to the originator and copied to the Purchasing file.

5.2 All persons using a PMI verification instrument for PMI verification must be qualified per Section 3.4.

5.3 The order will also specify that a Certified Material Test Report (CMTR) is to accompany the material delivery when required per Section 4.1.

5.4 An Authorized Inspector should verify any code material, including a review of CMTRs that specify heat treatment and mechanical properties, and PMI documentation.

*5.5 Receiving will verify the correct material match or element content. See paragraph 4.1.

5.6 Where applicable to the material order, ASME, ANSI, or similar code markings on the material will be verified and the flange rating will be verified by manufacturer's stamp and may include a sizing check using common measuring tools (i.e., a 6-inch scale or a tape measure) to screen for approximate dimensions.

5.7 All items must be stamped etched or color-coded to indicate that PMI verification was successfully completed. Refer to Appendix II, Color Code for Materials Identification, and Appendix III, Suggested Layout of Color Coding and Stamping and Field PMI Points.

5.8 The PMI performed by Purchasing must be documented and forwarded to the Purchasing file. The documentation should include:

1. Name of inspector.
2. Date of testing.
3. Parts inspected.
4. Type of test.
5. Results (that may include a breakdown in composition).

5.9 In cases where there is not a direct match of the alloy specified, Purchasing personnel should notify the originator of the order or work order for resolution. Purchasing and the work order originator may also seek guidance through the Refinery Materials Engineer or CRTC Materials Specialists by providing ordering information and a breakdown of elemental composition. Material changes that deviate from the original order shall be acknowledged and accepted in writing by the originator. Materials that are unacceptable for the process conditions shall be rejected and documented as such by Purchasing.

6.0 MAINTENANCE DEPARTMENT & PROJECT FIELD REP RESPONSIBILITIES

*6.1 All welding filler material shall be stored and distributed through designated Refinery locations, as referenced in the Richmond Refinery Filler Metal Policy. All welding consumables shall be organized and stored at these facilities according to AWS classification and size. The contents of opened containers of covered electrodes shall be stored in holding ovens that are clearly marked as to its contents at prescribed temperatures or discarded, as described in the Corporate Welding Manual or in the local Richmond Refinery Weld Inspection Requirements for Piping Fabrication document.

*6.2 When any welding filler metals are withdrawn (refer to the Filler Metal Policy), the following information shall be documented on a withdrawal log (Appendix IV) by the responsible party for a given Maximo or Engineering work order:

1. Job description and location (that matches work request and welding procedure requirements).

2. Date filler metal is issued.

3. Type, size, and amount of filler material issued.

4. Qualified welder's name or identification symbol.

5. Identification of joint or isometric to be worked on (pipe class, etc.).

6.3 Chevron Weld Inspection or Maintenance QA/QC personnel will audit this documentation.

6.4 PMI documentation must also be available for review by any Authorized Inspector.

6.5 Material verification of shop fabrication and field-installed systems is as follows:

1. Low alloy and alloy material that is picked up from Purchasing will be checked by the fabricator/installer to ensure it is clearly PMI stamped and piping and any other non-designated material color coded per Appendixes II and III, before fabrication begins. Material that is not clearly marked shall be segregated until further PMI inspection and reference to work orders has been made. All pipe cut in random lengths for field installation shall have the corresponding heat number (special heat-treated or impact tested and ASME Code Material) and/or color code transferred to the cut sections per Section 3.3.

2. It is recommended that a sample weld be tested and verified by PMI techniques for proper chemistry before welding begins. All shop welds and component materials will be verified as to their proper chemistry by testing the last pass with an acceptable PMI instrument. In addition, each material joined by a weld shall be verified by a PMI technique and the results documented on a construction isometric drawing and/or weld table.

6.6 All persons using a PMI verification instrument for PMI verification must be qualified per Section 3.4.

6.7 All shop welds will be stamped with the designated PMI stamp after the material has been verified per Appendix III or documented on construction isometric drawings, with any additional weld table data. All shop welds will be mapped on spool drawings and documented on the Weld Inspection Record or construction isometric drawing. The Weld Inspection Record and/or construction isometric will be filled out and passed on to the field crew with the shop fabrication spools and verified by weld inspection and QA/QC as applicable.

6.8 In cases where there is not a direct match of the alloy specified, Maintenance personnel should notify the originator of the order or work order for resolution. Purchasing and the work order originator may also seek guidance through the Refinery Materials Engineer or CRTC Materials Specialists by providing ordering information and a breakdown of elemental composition. Material changes that deviate from the original order shall be acknowledged and accepted in writing by the originator. Materials that are unacceptable for the process conditions shall be rejected and documented as such by Purchasing.

6.9 Shop fabrication and field-installed documentation is as follows:

1. All PMI welds will be mapped on the spool drawings and documented on the Weld Inspection Record table. The Weld Inspection Record consists of the following PMI items where applicable:

    a. Weld Procedure Specifications (WPS).

    b. Filler metal used (verified by PMI).

    c. PMI verification (of weld and component parts).

    d. Welder's ID number.

    e. Inspector's initials (who performed PMI).

    f. Ferrite Test results in (for 3XX stainless steels before post-weld heat treatment).

2. The pipe schedule or minimum wall thickness will be verified using UT gauging or calipers.

3. All welds requiring repairs will be noted on the Weld Inspection Record. All required inspections and documentation shall be repeated for the replacement weld.

4. Complete set of up-to-date isometrics and the Weld Inspection Record resulting from the fabrication and installation activities shall be maintained throughout the job. These records should be transferred from the shop with any shop-fabricated spools to the field crew, then to weld inspection or QA/QC for prestart-up safety review (PSSR) or filing with original work order as applicable.

5. The original or copies of all documentation will be passed from the Field Supervisor to the Area Weld Inspector at the completion of the job.

6. For daily and emergency off-hour repairs that may or may not include PMI and where no engineering is required, the Area Maintenance Supervisor or the weekend coverage supervisor is the responsible party for ensuring that these type repairs comply with this document (and any Management of Change). Maintenance must notify the Area Weld Inspector, qualified per Section 3.4, to verify Appendix I required weld and piping materials before returning a system to service. The Area Weld Inspector should complete Weld Inspection Report and/or an appropriate isometric drawing, and account for all PMI in the isometric database.

7.0 RELIABILITY DIVISION RESPONSIBILITIES

7.1 An Authorized Inspector, as defined by the applicable code of construction or repair, shall verify code material which may include PMI in addition to the review of CMTRs.

7.2 For field weld piping inspection, the Area Weld Inspector will field verify that all weld and component materials have been PMI checked for accuracy of field installed documentation and matched to the work order. All flanges and fittings will also be checked for proper markings and ratings.

7.3 The Area Weld Inspector will record the completed PMI inspection on the Inspection Piping Isometric Drawing, along with the weld inspection record number, date, and inspectors' initials. The inspector will complete the weld inspection record and properly file the document with the QA/QC records and input data to the Refinery isometric database.

7.4 In cases where there is not a direct match of the alloy specified, (weld) inspection or QC/QA personnel should notify the originator of the order or work order for resolution. Weld inspection or QC/QA personnel and the work order originator may also seek guidance through the Refinery Materials Engineer or CRTC Materials Specialists by providing ordering information and a breakdown of elemental composition. Material changes that deviate from the original order shall be acknowledged and accepted in writing by the originator. Materials that are unacceptable for the process conditions shall be removed and replaced with the appropriate material.

Appendix I - Materials and Components Requiring PMI Verification

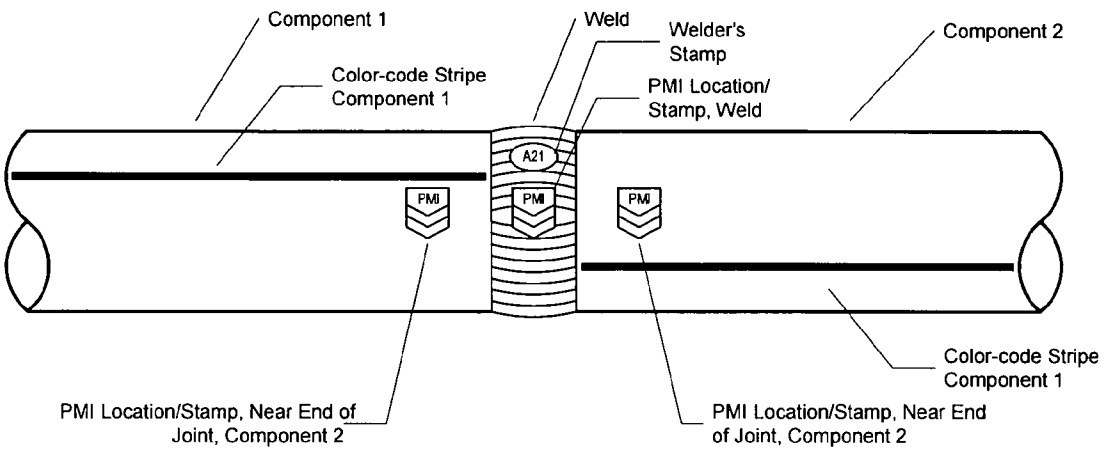
Item	Verification Required	Suggested Practices
API Class 3 Services	No	*"Services that are flammable but do not significantly vaporize when they leak and are not located in a high-activity area." Like tank-sampling stations.*
Special Heat-Treated, Impact Tested, or Low Temperature Carbon Steel	Yes	May have to rely on CMTRs since most analyzers recommended in this document do not measure carbon.
All Other Carbon Steels	No	Most analyzers recommended in this document do not measure carbon.
Nickel (low temperature) Carbon Steels	Yes	Includes pipe, plate, bar, and shapes.
Chrome-Moly Materials	Yes	Includes pipe, plate, bar, and shapes.
Stainless Steel	Yes	Includes pipe, plate, bar, and shapes, except API Class 3 Service.
Other High-Alloy Materials (Incoloy, Hastelloy, etc.)	Yes	Includes pipe, plate, bar, and shapes.
Alloy Flanges, Fittings, Thermowells	Yes	
Alloy Valves	Yes	Check body and stem, then packing and trim on engineering request.
Alloy Pump Cases	Yes	*PMI of pump shafts and other internal parts can mitigate premature failure through proper selection.*
Alloy Drains, Vents, and Plugs	Yes	
Tubing (>1" diameter)	Yes	Except API Class 3 Service, like tank sampling stations.
Instrumentation	No	Verify markings of pressure gauges.
Gaskets (ORJ, RTJ, etc.)	Yes	Use approved suppliers.
Alloy and Low Alloy Bolting	Yes	Use approved suppliers. Sample large lots.
Vessel, Heat Exchanger Shell Plate, Forging, etc.	Yes	Use approved suppliers. Rely on CMTRs for carbon steel, as stated above. Required by Authorized Inspector.
Heat Exchanger Bundles	No	*Supplier to sample alloy materials on request to mitigate premature failure due to improperly ordered material.*
Furnace Tubes	Yes	

Appendix II – Color Code for Materials Identification

Material	Color of Stripe(s)
Carbon Steel (<70 ksi, or 482.6 Mpa tensile strength)	No marking**
Carbon Steel (>70 ksi, or 482.6 Mpa tensile strength)	1 solid green**
Carbon steel, Killed Steel (see CMTR)	2 solid green**
Carbon Steel, Low Temperature, Impact Tested (see CMTR)	1 solid red
C-Mo Steel (not widely used or available)	1 solid orange**
1 Cr-1/2 Mo	1 solid orange, 1 solid blue
1-1/4 Cr- ½ Mo Steel	1 solid yellow**
2-1/4 Cr- 1 Mo Steel	1 solid blue**
5 Cr- ½ Mo Steel	1 solid white**
7 Cr- ½ Mo Steel	1 solid maroon**
9 Cr- ½ Mo Steel	1 solid white, 1 solid green**
Type 405 Stainless Steel	1 solid green, 1 solid black**
Type 410 Stainless Steel	1 solid green, 1 solid red
Type 410S Stainless Steel	1 solid green, 1 solid brown
Type 304 Stainless Steel	1 solid black**
Type 304L Stainless Steel	2 solid black**
Type 304H Stainless Steel	3 solid black**
Type 309 Stainless Steel	1 solid black, 1 solid brown
Type 310 Stainless Steel	1 solid green, 1 solid orange
Type 316 Stainless Steel	1 solid gray**
Type 316L Stainless Steel	2 solid gray
Type 316H Stainless Steel	3 solid gray
Type 317 Stainless Steel	1 solid brown, 1 solid white
Type 321 Stainless Steel	1 solid pink**
Type 321H Stainless Steel	2 solid pink
Type 347 Stainless Steel	1 solid brown**
Type 347H Stainless Steel	2 solid brown
Incoloy 800	1 solid black, 1 solid orange
Incoloy 800H (HT)	1 solid gray, 1 solid red
Incoloy 825	1 solid gray, 1 solid blue
Inconel 600	2 solid blue
Inconel 625	1 solid blue, 1 solid white
Hastelloy B	1 solid red, 1 solid white
Hastelloy C	1 solid red, 1 solid blue
Capenter 20 Cb-3	1 solid black, 1 solid blue
17-4 PH	1 solid black, 1 solid red
Monel 400	1 solid black, 1 solid yellow

**Color coding follows PFI ES-22

Appendix III – Suggested Layout of Color Coding and Stamping and Field PMI Points



Note 1: Orient pipes such that the color codes are in approximately the same orientation (without causing fit-up problems).

Note 2: For valves, fittings, etc., place the PMI stamp near the manufacturer markings.

Note 3: PMI stamps near welds should be placed near color-code stripes and similar markings, or between the 11 and 1 o'clock positions.

RICHMOND REFINERY INSTRUCTIONS

EQUIPMENT INSPECTION, MAINTENANCE, ETC.

APPENDIX IV
POSITIVE MATERIALS IDENTIFICATION

Date and Shift

Company Name

Appendix IV – SAMPLE Filler Metal Withdrawal Log

Time		Welder Symbol and Name	Filler Metal	Quantity	Diameter/ Size	Contract, Iso., and Work Order Number
Issued	Returned					

*REVISED: 12/11 (Replaces 10/06)
Certified as current and accurate: 12/11

642-IV

Appendix V – PMI Annual Audit

Date	Findings
Are the materials that require PMI clearly identified?	
Is Color Coding standardized and in place?	
Review the Withdrawal Log.	
Is Record Keeping up-to-date for PMI?	
Are training records in place for work groups required to perform PMI?	
Review documentation for Capital Projects.	
Review documentation for Routine Maintenance.	
Review documentation for IMPACT Team.	
Review documentation for P&MM.	
Action Item Owners	**Action Items and Due Dates**